

## A MONOGRAPH OF THE AUSTRALIAN LORICATES.

(Phylum MOLLUSCA—Order LORICATA.)

By TOM IREDALE and A. F. BASSET HULL.

## IV.

## Family LEPIDOPLEURIDAE.

This family, based on the absence of slitting in the insertion plates, appears to consist of heterogeneous elements; the species referred to it are mostly rare, the majority dwelling in deeper water and only secured when stones or other objects upon which they have settled are dredged. Some species have been procured from great depths, 2,000 fathoms or more. We have regarded the series as degenerates, mainly from an Isechnochitonoid source, the most characteristic feature being the posterior situation of the few gills. This cannot be regarded as an archaic feature, but as a phase of degeneracy. It must be obvious that a mollusk of this order must have developed the girdle by means of slit insertion plates, accompanied by gills the whole length of the body; and that by retrogression into deep water the slitting became unnecessary and the lengthy gills were not required. It is interesting to note that Thiele found that the radula varied so much that he concluded no description should be framed without the inclusion of the radular characters. This may be theoretically accepted, but practically it would mean the nondescription and consequent neglect of the whole of this family, save by radula specialists, whose number to-day can be counted on one hand.

The loss of slit insertion plates seems to be a present day feature in every group, beginning with the posterior valve. Thus *Lucilina* has the tail valve completely furnished with teeth in a notable insertion plate; *Onithochiton* is superficially inseparable, but when the posterior valve is examined interiorly it is seen to have a callus only, without teeth or slits. Other cases of unslit posterior valves can be seen in *Plaxiphora* (*sensu lato*), *Liolophura*, *Clavarizona*, *Lorica*, *Loricella*, *Kopionella*, *Cryptoplar*, and *Subterenchiton*, the lastnamed being an Isechnochitonid very similar to the Australian Lepidopleurids. A most interesting case is that of the Sumbanese *Hemiarthrum*, which proves to be a *Plaxiphora* with the anterior and median valves showing unslit insertion plates and degenerate external sculpture.

In Australian waters two groups of this family occur, which can be separated by means of the girdle covering and the external appearance, though interiorly the radular characters also differ:—

*Terenochiton*. Shell small, with girdle sealy; posterior valve normal.

*Parachiton*. Shell a little larger; girdle clothed with glassy spicules; the posterior valve generally disproportionately large.

Genus *TERENOKHITON*.

*Terenochiton* Iredale, Proc. Mal. Soc., xi., 1914, 28. Type by original designation *Lepidopleurus subtropicalis* Iredale.

*Lepidopleurus* of Australian writers, but not *Lepidopleurus* Risso, Hist. Nat. l'Eur. Merid., iv., 1826, 267. Type by subsequent designation (Buequoy, Dautzenberg and Dollfus, 1884) *Chiton cajetanus* Poli.

This group, proposed for a Keruadee shell, may include the Austral forms conchologically similar until the animals be examined; the type of *Lepidopleurus* is a very different shell, the conchological northern equivalent being *Leptochiton*. The sculpture in all the species is essentially alike, and the following descriptions are therefore comparatively formed, as when one member is identified the rest are immediately recognised by superficial likeness alone.

Shells of small size for the family, generally unicolored, of medium elevation, elliptical to oval, rarely elongate ovals; sculpture characteristic of the Austral members of the family (except *Hemiarthrum*, a Subantarctic shell doubtfully referable to the family in any phylogenetic sense) consisting of minute erect pustules, strung together on the central areas, obscurely forming rays on the anterior and posterior valves and lateral areas; girdle scales very small, oval, striate; insertion plates absent throughout, the sutural laminae small, triangular, very far apart.

Nearly all Loricates have a minute spiculate edge to the girdle, and through the lack of insertion plates *Terenochitons* curl their girdles upward at death, showing such spicules more clearly than usual. Some observers have mistaken such spiculate edge for the beautiful spiculate girdle of *Parachiton*, which, however, is quite distinct.

The Australian species of the genus *Terenochiton* are separable into two small groups (which may later prove to have distinct radular features) a smaller and a larger series, although all the shells are relatively small. The following is a key to the species:—

Shell small, broad:

Sculpture weak, irregular . . . . . *badius*.

Sculpture more pronounced, regular . . . . . *matthewsianus*.

Shell small, broader: areas not differentiated . . . . . *niger*.

Sculpture finer and more regular:

Mucro posterior . . . . . *erratus*.

Sculpture coarse . . . . . *sperandus*.

Sculpture on central areas much bolder . . . . . *liratus*.

Shell larger; elongate:

Concentric growth lines prominent . . . . . *liratus*.

*TERENOKHITON BADIUS*.

(Plate xxxix., figs. 1 and 2.)

*Lepidopleurus badius* Hedley and Hull, Rec. Aust. Mus., vii., 1909, 260, Pl. lxxiii., f. 1, 2. Port Jackson, N.S.W. Type in Australian Museum.

Shell small, oval, elevated, subcarinated, side slopes curved, median valves narrow, sutures straight. Colour pale to dark orange buff.

Anterior valve covered with minute scattered elevated pustules, not forming distinct rays.

Median valves: Lateral areas scarcely raised or differentiated, sculptured as anterior valve; pustules more massed but never rayed; central areas with similar pustulose sculpture, but pustules arranged in linear rows, not coalescing and

fairly regularly spaced, about fifty across the valve, not differentiated on the jugum, twelve pustules to a row.

Posterior valve; mucro anterior, elevated, at about anterior fourth; post-mucronal area a little concave, sculptured as anterior valve; ante-mucronal area very small, sculptured like central areas.

Girdle covered with very minute compressed elongate oval, striated scales.

Interior white. Slits none. Sutural laminae small, semi-triangular, distant.

Dimensions: 6 x 3.5 mm. (Type).

Station: Under sandstone embedded in sand, below low water mark.

Habitat: New South Wales, Victoria, South Australia.

Remarks: The foot of the animal is deep red in the New South Wales examples; while Ashby states that the South Australian examples have a buff foot. The shells from the latter locality are sculptured with larger pustules, having fewer and more perpendicular rows in the central areas, eight pustules to a row.

TERENOCHITON MATTHEWSIANUS.

(Plate xxxix., fig. 3.)

*Lepidopleurus matthewsi* Tate and May, Proc. Linn. Soc. N.S.W., 1901, 412. *Nom. nud.*

*Lepidopleurus matthewsianus* Bednall, Proc. Mal. Soc., vii., 1906, 92, pl. ix., f. 1-1f. Gulf, St. Vincent, South Australia. Type in coll. Matthews. Ashby, Trans. Roy. Soc. S. Aust., xlvii., 1923, 218, pl. xvi., f. 5, 5a. May, Illus. Index Tas. Shells, 1923, pl. xiv., f. 3.

This species is a little larger than the preceding; more elongated, round-backed, moderately depressed; lateral areas a little larger and better defined; sculpture throughout more regular, pustules regularly closely rayed on the anterior and posterior valves and lateral areas; 50 to 60 rays on anterior valve, 40 rays on posterior valve, 8 to 10 rays on lateral areas.

Posterior valve elevated, with mucro central; posterior slope straight.

Dimensions: 9 x 3.5. (Type).

Station: Below low water, under stones.

Habitat: South Australia, Victoria, Northern Tasmania.

Remarks: Shells from Port Lincoln, South Australia, show a still coarser sculpture.

TERENOCHITON NIGER.

*Lepidopleurus niger* Torr, Trans. Roy. Soc. S. Aust., xxxv., 1911, 105, pl. xxv., f. 5 a-f. Hopetoun, Western Australia. Type in coll. Torr. Ashby, *ib.*, xlvii., 1923, 220, pl. xvi., f. 4.

This shell is described as shorter, broader, and more depressed than *T. matthewsianus*, with no distinction between lateral, dorsal, and central areas of the median valves.

Dimensions: 4 x 2½ mm.

Station: Under a stone in a shallow pool.

TERENOCHITON ERRATUS.

(Plate xxxix., figs. 7-10.)

*Terenoichiton erratus* Hull, Aust. Zool., iv., 1923, 159, pl. xxiv., f. 6-9. Rabbit or Mistaken Island, King George Sound, Western Australia. Type in Australian Museum.

This shell is differentiated from *T. matthewsianus* by the more regular grain

striation of the sculpture, and the still more posterior mucro. The sculpture is a little finer in the central areas. Post-mucronal slope concave.

Dimensions: 5 x 3 mm. (Type), maximum length 10 mm.

Station: Under stones below low water mark.

Habitat: South Western Australia.

Remarks: When alive the shell is a pale rose colour which fades at death.

TERENOCHITON LIRATELLUS, n.sp.

(Plate xxxix, fig. 5.)

Like a miniature *T. liratus*; shell small, elongate oval, moderately elevated, subcarinated. Colour pink.

Anterior valve finely closely rayed with about fifty pustulose ribs.

Median valves: Lateral areas well differentiated and rayed similarly to the anterior valve; central areas strongly sculptured with fifteen longitudinal rows of pustules at each side, more distant and widely separated towards the margin, massed on jugum, but still distinct.

Posterior valve with mucro ante-median; post-mucronal area concave, sculptured as anterior valve, rays distinct; ante-mucronal area like central areas.

Interior: Pinkish-white.

Girdle: Covered with minute scales.

Dimensions:  $5\frac{1}{2}$  x 3 mm.

Station: Under stones on seaward side of rocky escarpment, below low water mark.

Habitat: Port Cartwright, South Queensland (Hull).

Remarks: Type in Queensland Museum.

TERENOCHITON SPERANDUS, n.sp.

(Plate xxxix, fig. 6.)

Shell small, depressed, semi-carinated, elongate oval, side slopes straight. Colour brownish-pink.

Anterior valve very large, regularly rayed with about sixty pustulose rays.

Median valves: Lateral areas similarly rayed with eight rays; central areas longitudinally regularly ribbed with about twenty-five pustulose rays across the valve, closer together on the jugum, separating a little laterally.

Posterior valve with mucro ante-median, elevated; ante-mucronal area very small; post-mucronal area concave; sculpture as on anterior and median valves.

Girdle covered with minute scales.

Dimensions: 4 x  $2\frac{1}{2}$  mm.

Station: Dredged in 70 fathoms, off Ulladulla (C. W. Mulvey).

Habitat: New South Wales.

Remarks: Type in the Australian Museum.

TERENOCHITON LIRATUS.

(Plate xxxix, fig. 4.)

*Lepidopleurus liratus* H. Adams and Angas, P.Z.S., 1864, 192. Yorke's Peninsula, South Australia. Type lost.

*Lepidopleurus inquinatus* of Australian workers since 1896, but not *Chiton inquinatus* Reeve, Conch. Icon., iv., 1847, pl. xxiii., sp. and f. 154. Van

Diemen's Land in error = New Zealand. Type Mus. Cuming in Brit. Mus.

*Lepidopleurus liratus* Iredale and May, Proc. Mal. Soc., xii., 1916, 99. Ashby,

Proc. Roy. Soc. Vict., xxxiii., 1921, 155. Trans. Roy. Soc. S. Aust., xlvii., 1923, 218, pl. xvi., f. 1.

This species is larger, more elongate, semi-carinated, side slopes a little curved, a notable feature being the strong concentric ridge formation, suggesting long growth periods. The anterior valve is closely radially rayed with very small pustules packed together, about eighty rays being counted; six deep concentric grooves form a characteristic item; these growth grooves occur all round the shell, on the lateral areas of the median valves and the post-mucronal area of the posterior valve; the central areas are more openly sculptured than in any of the preceding species, the pustules being strung together and widely separated laterally, six to eight crowded and straight on the jugum, ten to twelve irregular and obliquely slanting rows on each side.

Posterior valve normal, mucro elevated, central; post-mucronal slope concave.

Girdle covered with minute rounded striated scales.

Interior pinkish-white; sutural laminae small, triangular, distant.

Dimensions: 9 x 4 mm.

Station: Under stones below low water mark.

Habitat: South Australia. (? Victoria).

Remarks: The neotype described is from Hardwicke Bay, the type locality.

#### GENUS PARACHITON.

*Parachiton* Thiele. Revision Chitonen (Chun's Zoologia, heft 56), Part 1, 1909,

14. Type by monotypy *Lepidopleurus (Parachiton) acuminatus* Thiele.

Shells more elongately ovate than the preceding forms; median valves deep; the posterior valve large, generally being abnormally long, with the mucro posterior to sometimes terminal; moderately depressed; of pure white or delicately pinkish colouration; sculpture as in *Terenochiton*, but always finer and more elegant; the girdle covering consisting of fine elongated glassy spicules. Interior and other shell features as in *Terenochiton*.

This group was proposed by Thiele for a Lepidopleurid of peculiar superficial appearance which showed a distinct style of radula. The notable shell feature is the elongated posterior valve, and the species appear to be widespread throughout the Austral-Neozelanic area in deeper water. One species occurs on the littoral in Port Jackson.

Although the description reads somewhat like that of *Deshayesiella*, autoptic examination shows that no relationship exists. The species can be easily separated by means of the position of the mucro and the sculpture. Two series may be recognised, the northern forms with the true exaggerated posterior valve, and the southern forms with the posterior valve large but not extraordinarily so. These latter appear to be more closely related to *Terenochiton* through *T. liratus*.

The following is a key to the species of *Parachiton*:—

Posterior valve abnormally large:

Shell round-backed:

Sculpture coarse, bolder, laterals rayed . . . . . *puppis*.

Sculpture fine, laterals indistinctly rayed . . . . . *litoreus*.

Sculpture weak; no raying on laterals . . . . . *capricornicus*.

Posterior valve not abnormally large:

Shell highly elevated:

Sculpture regular, carinated . . . . . *columnarius*.

Sculpture confused granules only . . . . . *opiparus*.



Shell moderately elevated, slightly carinated:

Mucro post-median . . . . . *collusor*.

Shell moderately elevated, not carinated:

Mucro ante-median . . . . . *profundus*.

#### PARACHITON PUPPIS.

(Plate xxxix., figs. 15-19.)

*Parachiton puppis* Hull, Aust. Zool., iii., 1923, 158, pl. xxiv., f. 1-5. Vacluse, Port Jackson, N.S.W. Type in Aust. Mus.

Shell elongate, thin, narrow, round-backed, moderately elevated, with a suggestion of carination. Colour chalky white when alive, becoming pale buff when dried. The sculpture is uniformly grain-striate.

Anterior valve finely closely rayed, over 100 of the minutely grained striae may be counted at the anterior margin.

Median valves: Lateral areas distinctly raised, radially striate, the rays very numerous and crossed by three or four deep growth lines; central areas closely finely ridged with regular straight rows of coalescing granules, larger than those on the lateral areas.

Posterior valve very large, mucro elevated, at about the posterior fifth, post-mueronal slope steep, concave; post-mueronal area very small, sculptured as anterior valve; ante-mueronal area disproportionately long, sculptured as central areas.

Girdle densely clothed with fine elongate glassy spicules.

Interior pearly white; sutural laminae small, triangular, distant.

Dimensions: 12 x 5½ mm., (Type): maximum 16 x 8 mm.

Station: Under stones embedded in mud or soft sand, below low water mark.

Habitat: Port Jackson, New South Wales.

Remarks: This is a somewhat rare species, and so far it has been taken in a restricted area at Vacluse (Watson's Bay). The animal is large, soft, and generally distended with water; the foot transparent and extending laterally beyond the shell on both sides. When dried, the body contracts forward, leaving the gill rows distinctly visible in the posterior cavity. The resemblance of the posterior valve in shape to the stern of a cruiser suggested the specific name.

#### PARACHITON LITOREUS, n.sp.

(Plate xxxix., fig. 13.)

Shell elongate, depressed, round-backed. Colour cream.

Anterior valve finely rayed with about 100 pustulose rays.

Median valves: Lateral areas indistinctly rayed, about 20, visible only at an angle in a strong light; central areas having about 60 longitudinal rows of fine pustules, fairly evenly spaced throughout.

Posterior valve large; mucro nearly terminal, elevated; post-mueronal slope deeply concave, small, no ray formation discernible.

Girdle finely spiculate.

Dimensions: 10 x 4 mm. (curled).

Station: On the beach.

Habitat: Murray Island, Torres Strait.

Remarks: This shell was collected by Mr. C. Hedley. The type is in the Australian Museum.

PARACHITON CAPRICORNICUS, n.sp.

(Plate xxxix., fig. 14.)

Shell elongate, round-backed, moderately elevated, glossy. Colour pale pink. Sculpture as in *P. litoreus*, but the pustules are very small and strung together into fine lines.

Median valves: Lateral areas a little raised, more glossy than the central; pustules larger and more separated; raying obsolete; faint growth lines; central areas regularly finely longitudinally lined with pustulose lines.

Posterior valve abnormally large; mucro nearly terminal.

Dimensions: 12 x 4 mm. (curled).

Station: Dredged in 17-20 fathoms.

Habitat: Masthead Reef, Capricorn Islands, Queensland.

Remarks: This shell was collected by Mr. C. Hedley. The type is in the Australian Museum.

PARACHITON COLUMNARIUS.

(Plate xxxix., figs. 11-12.)

*Lepidopleurus columnarius* Hedley and May, Rec. Aust. Mus., vii., 1908, 213, pl. xxiv., f. 27, 28. Off Cape Pillar, south coast of Tasmania. Type in Aust. Mus. May, Illus. Index Tas. Shells, 1923, pl. xiv., f. 1. Ashby, Trans. Roy. Soc. S. Aust., xlvii., 1923, 219, pl. xvi., f. 3, 3a.

*Lepidopleurus pelagicus* Torr, Trans. Roy. Soc. S. Aust., xxxvi., 1913, 165, pl. v., f. 2 a-f. Off Cape Jaffa, South Australia. Type in coll. Torr. Ashby, *id*, *ib*., xlvii., 1923, 220, pl. xvi., f. 3b.

Shell elongate, thin, much elevated, arched, sub-carinated. Colour pinkish.

Anterior valve closely rayed with 100 very fine pustulose rays.

Median valves deep; lateral areas rayed with about 20 rows; slightly differentiated; central areas longitudinally ribbed, about fifty distinct fine pustulose ribs, more closely packed on the jugum.

Posterior valve with mucro behind the middle; post-mucronal slope rather steep.

Dimensions: 8 x 3 mm. Type (curled).

Station: Dredged in 100 fathoms.

Habitat: Tasmania, South Australia, Victoria.

Remarks: Torr's *P. pelagicus* is described as decidedly arched and strongly carinated; the mucro is median and elevated. This description does not agree with the type of Hedley and May's shell, and therefore Torr's shell may be regarded as sub-specific until further material is available for examination.

PARACHITON OPIPARUS, n.sp.

(Plate xxxix., fig. 20.)

Shell somewhat resembling *P. columnarius*, but though highly arched it is not carinated. Colour pink.

Sculpture very fine throughout, no distinct rays or lines can be seen with a lens, only a compact finely pustulose surface giving a matt appearance. The lateral areas of the median valves are only indicated by a slight fold.

Posterior valve not abnormally large; mucro post-median; post-mucronal slope concave.

Girdle very finely spiculose.

Dimensions: About 10 x 5 mm. (curled).

Station: Dredged in 100 fathoms.

Habitat: Off Cape Wiles, South Australia.

Remarks: This shell was collected by Mr. C. Hedley. The type is in the Australian Museum.

The whole appearance of this shell differs so much from that of the typical *Parachiton* that it is suggested it is no near relation, but in the meanwhile until further material is secured we place it in this genus.

PARACHITON COLLUSOR, n.sp.

(Plate xxxix., fig. 22.)

*Lepidopleurus profundus* Ashby, Trans. Roy. Soc. S. Aust., xlvii., 1923, 221, pl. xvi., f. 2, 2a. Gulf St. Vincent, S.A. Type in coll. Ashby.

Shell somewhat resembling *P. profundus* May, but larger, round-backed, semi-carinated. Colour pinkish.

Anterior valve closely rayed with fine pustules, about 100 rays; three deep concentric growth lines close together near the margin.

Median valves: Lateral areas finely rayed, rays divaricating, but only about fifteen counted, six growth lines (or periods) close together near the margin; central areas finely ridged with lines of pustules massed on the jugum, separating somewhat irregularly and slanting laterally, twenty-five on each side, spaces between latticed with fine lines.

Posterior valve large but not abnormal; mucro a little behind the middle.

Girdle clothed with fine glassy spicules.

Dimensions: 18.5 x 6 mm. (curled). Ashby's type 20 x 6.5 mm.

Station: Dredged.

Habitat: South Australia. Victoria.

Remarks: This shell looks like a deep water form of *Terenochiton liratus* in which the girdle scales have been replaced by spicules. Compared with May's *P. profundus* the sculpture of the central areas is finer; the mucro is more posterior.

PARACHITON PROFUNDUS.

(Plate xxxix., fig. 21.)

*Lepidopleurus inquinatus* Sykes, Proc. Mal. Soc., ii., 1896, 86, pl. vi., f. 4, and of Australian workers since, but not *Chiton inquinatus* Reeve, Conch. Icon., iv., 1847, sp. and f., 154. Van Diemen's Land in error = New Zealand. Type in Mus. Cuming in Brit. Mus. Ashby, Proc. Roy. Soc. Vict., xxxiii., 1921, 155 (error only), corrected in Trans. Roy. Soc. S. Aust., xlvii., 1923, 217.

*Lepidopleurus profundus* May, Illust. Index Tas. Shells, 1923, Appendix ex Ashby M.S. for *L. inquinatus* pl., xiv. Ten fathoms off Pilot Station, River Derwent; 15 fathoms Geographe Strait, Tasmania. Type in coll. May.

Shell small, elongate oval, moderately elevated, not carinated; posterior valve not much elongated. Colour pinkish-cream.

Anterior valve closely finely rayed with rows of small pustules, coalescing and intercalating rays intervening with growth, the rays numbering up to 100.

Median valves rather deep; the lateral areas finely rayed as the anterior valve, rays similarly intercalating, about fifteen ribs at edge of valve; central areas strongly ridged longitudinally with rows of nearly separated pustules, the interstices wide towards the side and finely latticed, these ribs appearing as if thrown off the lateral areas and thence traversing the central areas, about twenty on each side of the jugum; the jugal area being indicated by about ten of these rows massed together.



Posterior valve not as large as usual in this genus; mucro ante-median and elevated; post-mucronal area a little concave, sculpture like that of anterior valve; ante-mucronal area sculptured like central areas; growth lines notable as weak terraces on the lateral areas, as concentric grooves toward the margin of the anterior valve, but scarcely marked on the posterior valve.

Girdle covered with slender glassy spicules.

Interior pinkish-white; sutural laminae small, triangular, distant.

Dimensions: 10 x 5 mm.

Station: Dredged in 10 fathoms off Pilot Station, River Derwent (Estuary), Tasmania. (? Victoria).

Remarks: The foregoing description is the first published of May's species, and is based upon one of the original series from which the author figured the species.

#### Family LEPIDUCHITONIDAE.

This family, of world-wide distribution, comprises species characterised by the nature of the girdle covering and the peculiar insertion plates; the radular features allying them to the Isechnochitonidae, of which they may be a very early offshoot, much specialised. The majority of species live in the Southern Hemisphere, but some occur in the North, where *Isechnochiton* is absent.

Shells varying in size from small to large (the largest species live in Tasmania and New Zealand, and have developed a secondary girdle covering of scattered corneous processes), depressed or elevated; colouration generally dark, (reds, browns, and purples predominating); sculpture of coarse granulation, but a few species with longitudinal ditches on the central areas; girdle leathery, generally densely clothed with elongated spicular scales, packed latitudinally so as to form a carpet-like edging commonly of greater width than usual in the scaly girdled Loricates, and with scattered corneous processes in a few instances; insertion plates long, thick, brittle, and coarsely denticulate; usually more than one slit in the insertion plates of the median valves; the sutural laminae commonly continuous. Eyes have been recorded in this family by Torr in connection with *Icoplar mayi*, from South Australia, and by Odhner for a New Zealand species. We find them present in all the species here dealt with; very rarely seen in *Eudoxoplax*, a few discovered in *Levicoplax*, more notable in *Icoplar*, being abundant in *I. luminosa*, in which species the ocelli are rayed more regularly than in *Lucilina*, etc., but not so clearly visible to the naked eye.

The differential characters of the genera may be epitomised as follows:—

Girdle without corneous processes; less than 20 slits in terminal valves:—

Shell highly elevated:

Central areas deeply grooved . . . . . *Icoplar*.

Shell varying from depressed to moderately elevated:

Central areas smooth, with occasional pits in valves vi. and vii. *Levicoplax*.

Girdle with scattered corneous processes; more than 20 slits

in terminal valves . . . . . *Eudoxoplax*.

#### Genus ICOPLAX.

*Icoplar* Thiele, Das Gebiss der Schnecken (Troschel), II., 1892, 392. Type by monotypy *Chiton puniceus* Couthouy.

Shell of medium size, highly elevated, somewhat broadly ovate; colour little variable, dull; central areas deeply longitudinally grooved; lateral areas notably raised; girdle composed of long slender curved spicules placed latitudinally so that about one-third is seen, the whole presenting a textile appearance. (In

dried specimens the girdle sometimes cracks, and the spicules become displaced, when they resemble the bunches of siliceous spicules seen in other groups).

#### ICOPLAX MAYI.

(Plate xxxix., figs. 23-27.)

*Callochiton mayi* Torr, Proc. Roy. Soc. Tas., 1912, 1, pl. 1, f. 5-7. Stanley, North-west Tasmania. Type in coll. Torr. Trans. Roy. Soc. S. Aust., xxxvi., 1912, 164, pl. v., f. 1 a-f. Spencer Gulf, South Australia. May, Illustr. Index Tas. Shells, 1923, pl. xiv., f. 6.

Shell medium, ovate, elevated, carinated, side slopes straight. Colour greenish with a few brown markings, end valves brown. The whole shell is minutely granulate, the surface dull (matt).

Anterior valve: Apex elevated.

Median valves with lateral areas very elevated, granulate; central areas with deep longitudinal channels, about eleven in each side, the lateral five extending across the valve, the next three median ones extending only half way across, and three small, almost pits, approaching the jugum.

Posterior valve with mucro ante-median; post-mucronal slope nearly straight; ante-mucronal area grooved as central areas.

Girdle broad; scales generic. Interior rose; slits 16-3-12.

Dimensions: 15 x 8 mm. (Type). 20 x 12 mm. (Maximum).

Station: Under stones below low water mark.

Habitat: Tasmania (North and East), Victoria, South Australia.

Remarks: This is a rare species. It resembles the type of the genus.

#### ICOPLAX RUFA.

*Callochiton platessa* Sykes, Proc. Mal. Soc., ii., 1896, 86. Victoria, *vide* Ashby, Proc. Roy. Soc. Vic., xxxiii., 1921, 150.

*Callochiton rufus* Ashby, Trans. Roy. Soc. S. Aust., xxiv., 1900, 87, pl. i., f. 2 a-g. Gulf St. Vincent, South Australia. Type in coll. Ashby.

? *Callistochiton rufus* Ashby, Thiele, Die Fauna Sudwest Aust., iii., 1911, 402. Sharks Bay, W.A.

Shell medium, broadly ovate, carinated, side slopes curved. Colour bright terra-cotta red, with white spots on dorsal area of some valves, and white lateral area of valve vii.

The sculpture of the whole shell consists of rather widely separated small pustules arranged in quincunx. The lateral areas of the median valves are distinctly raised, having two or three faint vertical sulci; central areas longitudinally ribbed with scimitar-shaped riblets; dorsal area raised, wedge-shaped, divided from the central areas by a deep spindle-shaped pit, tapering off into a curved groove at the anterior margin. Posterior valve with mucro median, and although shallow, decidedly more prominent than in *L. platessa*; ante-mucronal area traversed by eight longitudinal strongly raised ribs, similar to those of the central areas of the median valves; post-mucronal area smooth.

Girdle broad, leathery, densely clothed with evenly packed elongate scales arranged in rows, the apices curving across to the next row.

Interior: Slits 11-2- .

Dimensions: 16 x 10 mm.

Station: Dredged.

Habitat: South Australia, Victoria. ? Western Australia (Thiele).

Remarks: Only one specimen was dredged in Gulf St. Vincent by Sir Joseph Verco. Although we have not seen the type, Ashby's figures furnish indications

of a sculpture intermediate between *I. mayi* and *L. platessa*. The identification by Sykes of the shell collected by Bracebridge Wilson, as *L. platessa* is shown by Ashby to be erroneous.

ICOPLAX LUMINOSA, n.sp.

(Plate xxxix., figs. 28, 29.)

Shell very small, elongate oval, elevated, sub-earinated. Colour reddish-brown.

The whole shell is minutely sculptured as in the genus; under the microscope eyes are seen very numerous ranging on the anterior and posterior valves and lateral areas; the central areas of the median valves and the ante-mucronal area of the posterior valve having three or four deep longitudinal grooves on each side, the lateral two of which cross the valve, the next extends more than half way, and the one nearest the jugum less than half way across; lateral areas much raised.

Posterior valve with mucro elevated, central, post-mucronal slope straight or a little convex.

Girdle wide, characteristic of the family.

Interior rose; slits 12-2-12; teeth thick, scarcely denticulate; solid; sutural laminae continuous.

Dimensions: 6 x 3 mm.

Station: Dredged in 17-20 fathoms.

Habitat: Masthead Reef, Capricorn Group, Queensland.

Remarks: This species seems to come close to *Callochiton sulcatus* Nierstrasz, Siboga Exped. Monog., xlviii., 1905, 35, pl. 1, f. 8, pl. iii., f. 66-69, from shore Sula Bear and 8-10 M, Moluccas. The type was collected by Mr. C. Hedley, and is in the Australian Museum.

Genus LEVICOPLAX, n. gen.

Type, *Chiton platessa* Gould.

*Callochiton* of recent Australian writers, but not *Callochiton* Gray, P.Z.S., 1847, 126. Type, *Chiton laevis* Pennant.

Shell medium to large, elevated or depressed, elongate to rounded oval, carinated or round-backed. Colour variable, apparently of a protective nature, reds, pinks, browns and greens agreeing with environment, but almost entirely evanescent, becoming uniformly dull red or brown when dry. Sculpture minutely granulose; matt; lateral areas scarcely raised; girdle scales as in preceding genus.

LEVICOPLAX PLATESSA.

(Plate xxxix., fig. 30.)

*Chiton platessa* Gould, Proc. Bost. Soc. Nat. Hist., ii., 1846, 143. New South Wales = Port Jackson. Type lost (?). U.S. Expl. Exped., 320, atlas, f. 434, 434a.

*Lepidopleura platessa* Gould, Otia Conch., 1862, 242.

*Chiton crocinus* Reeve, Conch. Icon., iv., 1847, sp. 146, pl. xxii., f. 146. Hab. ? = New South Wales. Type in Mus. Cuming in Brit. Mus.

*Chiton versicolor* A. Adams, P.Z.S., 1852, 92, pl. xvi., f. 5. Sydney, N.S.W. Type in Mus. Cuming in Brit. Mus. Not *Chiton versicolor* Sowerby, Mag. Nat. Hist., 1840.

*Callochiton platessa* Pilsbry, Man. Conch., xiv., 1892, 49, pl. 10, f. 1-5. May, Illus. Index Tas. Shells, 1923, pl. xiv., f. 7.

*Callochiton platessa* var. *fossa* Ashby, Trans. Roy. Soc. Aust., xvi., 1922, 19,

pl. iii., f. 4. Gulf St. Vincent, South Australia, and Sydney, N.S.W.  
Type in coll. Ashby.

Shell medium to large, round-backed to earinated, moderately broad to elongate oval, girdle wide. Colour varying according to environment, but fugitive, dried shells becoming brown, brownish-red, or dull greenish. The sculpture of the whole shell consists of a minute pustulation forming a coarse, matt surface.

Anterior valve rather small; lateral areas of median valves scarcely raised, elevation marked by a shallow depression; posterior valve with mucro central, elevated or planate.

Girdle broad, thin, densely clothed with very fine elongated scales.

Interior generally bluish-white with a rose centre; slits 14-16; the sutural laminae continuous but becoming interrupted in valves vi.-viii.

Dimensions: 47 x 29 mm. (Maximum of series from Vaucluse, New South Wales).

Station: Under, or on the upper side of stones below low water mark.

Habitat: South Queensland, New South Wales, Victoria, Tasmania, South Australia, South Western Australia.

Remarks: When alive this shell is covered with a glutinous epidermis which appears to contain the fugitive protective colours. The variation in elevation and breadth of individual specimens is perhaps greater than in any other species of Loricata. In a small percentage of specimens collected in New South Wales a few short sulci may be found, particularly on valves vi., vii., and viii., in the central areas. This variety has been distinguished by Ashby as variety *fossa*, and he records it also from South Australia. As his figured example was a Port Jackson shell, we designate that as the type locality of the variety. South Australian specimens differ, being coarser in sculpture, and probably not attaining such large proportions as the extreme eastern and western examples. We have valves from Foul Bay, S.W. Australia, collected by Mr. S. W. Jackson, which indicate the existence of a much larger and flatter shell, with shorter insertion plates, and still coarser sculpture.

#### LEVICOPLAX ELONGATA.

*Callochiton elongatus* May, Proc. Roy. Soc. Tas., 1919, 55, pl. 14, f. 1 a, b.

Type in coll. May. Illus. Index Tas. Shells, 1923, pl. xiv., f. 5.

Shell small, elongate, moderately elevated, not earinated. Colour pinkish-brown, mottled with green.

Sculpture as in *L. platessa*, but a little finer; posterior valve large, mucro elevated, ante-median, ante-mucronal area very small, post-mucronal area large, posterior slope nearly straight.

Girdle wide, scales much coarser than those of *platessa*, appearing almost as oval, not linear scales.

Interior: Pinkish. Slits 10-12; continuity of sutural laminae variable.

Dimensions: 7.4 x 3.6 mm. (Type), 9 x 5 maximum.

Station: Under stones below low water mark.

Habitat: Norfolk Bay and Port Arthur, Tasmania.

#### GENUS EUDOXOPLAX.

*Eudoxoplax* Iredale and May, Proc. Mal. Soc., xii., 1916, 94. Type by monotypy

*Chiton inornatus* Tenison-Woods.

Shell large, moderately elevated, broadly ovate; girdle very wide, thin, leathery, with a few scattered horny processes. Sculpture similar to that of

*Lericoplar*, but no trace of sulcation in the central areas. Interior, slits numerous, anterior 24 to 27, median 4 to 7, posterior valve 20 to 27, teeth solid, grooved, scarcely denticulate, sinus narrow, deep, but sutural laminae continuous.

EUDOXOPLAX INORNATA.

(Plate xl., fig. 1.)

*Chiton inornatus* Tenison-Woods, Trans. Roy. Soc. Vict., xvii., 1881, 82, pl. f.

8, 9. North Tasmania. Type in Tasmanian Museum.

*Callochiton lobatus* Filsbry, Man. Conch., xiv., 1892, 53, pl. 8, f. 83-85, ex Cpr.

M.S. Tasmania. Type in Mus. Cuning in Brit. Mus.

*Eudoxoplax inornatus* May, Illus. Index Tas. Shells, 1923, pl. xiv., f. 4.

Shell large, elongate oval, moderately elevated, sub-carinated, side slopes curved. Colour bright red when alive, drying to dark chocolate-brown, sometimes with patches of green or yellow on one or two valves.

Sculpture of the whole shell minutely granulose in quincunx; not glossy. Anterior valve broad, not very deep; median valves with lateral areas little elevated; posterior valve with nucro elevated, ante-median, posterior slope a little concave.

Interior bluish-white, brownish in centre; slits as in genus, slit rays very deep and extending almost to the centre of each valve.

Girdle very broad, leathery, densely clothed with minute elongated suberect siliceous spinules and with a few scattered corneous processes; sinuate posteriorly.

Dimensions: 75 x 44 mm.

Station: Under stones below low water mark.

Habitat: Tasmania.

Remarks: Examples from southern Tasmania (Port Arthur) are larger, more elevated, and comparatively broader than those from the north and east. The foot of the animal is a bright salmon-red.

Family CALLISTOCHITONIDAE.

The superficial appearance of members of this family has brought together a group of world-wide range, especially developed on the American coast, also common in Australia, but absent from New Zealand. By means of the radular features Thiele has associated these with the Ischnochitonids, but has placed in the genus *Callistochiton* species conchologically quite unlike.

Shells small to medium, elongate ovals, of moderate elevation; generally uniform colouration; sculpture remarkably bold, 8 to 12 elevated ribs on the anterior and posterior valves and 2 ribs on the lateral areas, these ribs composed of massed nodules, in one genus of coalescing granules; central areas with longitudinalinals of similar formation but much weaker; girdle scales oval, sometimes very compressed, striate; insertion plates generally showing scalloping in agreement with the external ribs; sutural laminae large, sometimes continuous.

The following is a key to the genera:—

Girdle scales not polished, striate; scalloping present:

Sutural laminae separated . . . . . *Callistelasma*.

Sutural laminae continuous . . . . . *Callistassecla*.

Girdle scales not polished, striate; scalloping obsolete:

Sutural laminae separated:

Superficial sculpture diagnostic . . . . . *Lophochiton*.

Girdle scales polished, striate; scalloping absent . . . . . *Solivaga*.



Genus *CALLISTELASMA*, n. gen.Type, *Chiton antiquus* Reeve.*Callistochiton* of Australian workers, but not *Callistochiton* Dall, Proc. U.S.Nat. Mus., 1881, 283, 289, 290 (Feb. 1882), of which the type is *Chiton pulchellus* Gray.

Shells small to medium, elongate oval, round-backed, rarely carinated, girdle wide; colouration modest. Sculpture bold, of elevated nodose ribs on end valves and lateral areas, central areas ridged; girdle scales minute, oval, chaffy, not polished, striate, elongate, compressed, rarely roundish; insertion plates generally notably festooned; slits agree in number and position with the external ribs; sutural laminae distant.

(The type of *Callistochiton* is a South American species, superficially like the Australian shells, but having a posterior valve more like *Lophochiton*, the teeth thrown more forward, and the sutural laminae widely separated; the girdle scales smooth).

*CALLISTELASMA ANTIQUA*.

(Plate xl., fig. 6.)

*Chiton antiquus* Reeve, Conch. Icon., iv., 1847, pl. 25, sp. and f. 169. Australia—Port Jackson, New South Wales. Type in Mus. Cuming in Brit. Mus.

*Chiton apparatus* Angas, P.Z.S., 1867, 223, ex Carpenter M.S., in synonymy of *C. antiquus* Reeve. Port Jackson.

*Callistochiton sarcophagus* E. A. Smith, Rep. Zool. Coll. Alert, 1884, 79, ex Carpenter M.S. in synonymy of *C. antiquus*. Type in Mus. Cuming in Brit. Mus.

*Callistochiton antiquus* Haddon, Zool. Challenger Polypl., 1886, 20. Pilsbry, Man. Conch., xiv., 1893, 274, pl. 59, f. 29-35. Iredale and May, Proc. Mal. Soc., xii., 1916, 114, pl. iv., f. 5a.

Shell of medium size, regular oval, moderately elevated, not carinated, side slopes curved, girdle wide. Colour from pale buff to reddish-brown, sometimes black, rarely bluish-green.

Anterior valve with ten to twelve elevated nodose ribs, twelve nodules marked on a medium specimen, nodules transversely elongate, interstices minutely granose.

Median valves: lateral areas with two similar elevated nodose ribs, the posterior one tending to duplicate with age, and markedly elongate nodulose, interstices minutely granose; central areas ridged with a dozen rows of small coalescing pustules at each side; latticed between with fine lines; jugal area with crisscross sculpture.

Posterior valve with nuero median, planate; post-nucronal area a little convex, sculptured as anterior valve; ante-nucronal area as central areas.

Girdle wide; scales very small, oval, striate.

Interior bluish-green; slits 8 to 10-1-10 to 12.

Dimensions: 50 x 17 mm.

Station: Under dirty stones between tide marks.

Habitat: Southern Queensland, New South Wales. Victoria (East only).

Remarks: This shell frequents stones embedded in muddy sand, or where numbers of stones are massed together with debris of dead shells and rubbish. Its colour is protective, and varies from light to dark in accordance with its surroundings. It is sluggish, becoming sedentary with age, when it is frequently encrusted with serpularia and other growths.

CALLISTELASMA MERIDIONALIS.

(Plate xl., fig. 2.)

*Callistochiton antiquus meridionalis* Ashby, Trans. Roy. Soc. S. Aust., xliii., 1919, 400, pl. xlii., f. 7. Marino, South Australia. Type in coll. Ashby.

*Callistochiton antiquus mayi* Ashby, ib., id., p. 401, pl. xlii., f. 8, 9. Penguin, North Coast, Tasmania. Type in coll. Ashby. May, Illus. Index Tas. Shells, 1923, pl. xv., f. 8.

Easily separable from the preceding species by the lack of development of the linear ridges on the central areas, these only appearing as slanting lines near the sides of the valves, all the remainder of the area being sculptured in criss-cross, forming pits. This is beautifully shown in young shells, such as the type of *C. mayi*, and observable in the oldest shells, which are commonly larger than the average New South Wales shell.

The insertion plates are similar to those of the preceding species, but the sutural laminae are rounder and more distant, a wide deep sinus being present. The scales are similar in the juvenile, but in the senile shells they are more rounded and separated.

Habitat: Victoria, South and South-west Australia, Northern Tasmania.

Remarks: Examples from King George Sound, Western Australia, are more finely sculptured in the central areas. It is possible that examination of a series from the west may justify separation of a subspecies, for which we suggest the name *hesperia*.

CALLISTELASMA PERIQUINIA, n.sp.

(Plate xl., fig. 8.)

*Callistochiton antiquus* Smith, Rep. Zool. Coll. Alert, 1884, 79 (Port Molle).

Distinguishable from *C. antiqua* by the distinctly annulate character of the nodules on the ridges of the lateral areas; the consistently broader posterior ridge; the more numerous (13 on each side) longitudinal lines in the central areas; the fine latticing so characteristic of the southern shell is present.

Habitat: Northern Queensland (Mackay to Cooktown).

Remarks: E. A. Smith identified the shell collected by Coppinger of the *Alert* as Reeve's *C. antiquus*. Coppinger's example was taken at Port Molle, Whitsunday Passage, Queensland. We have examined shells from Mackay, Grassy Island (Whitsunday Group), Port Denison, and Howick Islands, north of Cooktown, all of which consistently show the variations from *C. antiqua* detailed above.

CALLISTELASMA GENEROS, n.sp.

(Plate xl., figs. 3 and 4.)

Shell medium, elongate oval, depressed, round-backed. Colour greenish-white, with fine black lines and greenish blotches. Umbones pink.

Anterior valve ten-ribbed, ribs obsoletely nodulose, interstices roughly pustulose.

Median valves: Lateral areas two-ribbed, the anterior one duplicating, sub-nodulose; posterior one with a succeeding line of obscure pustules; central areas with jugal tract minutely pustulose, almost smooth, merging laterally into a rude crisscross sculpture, succeeded by five slanting ridges extending to the margin, with smooth intervals.

Posterior valve with mucro smooth, ante-median, depressed; post-mucronal slope straight; post-mucronal area ten-ribbed, ribs a little more nodulose than those of valves i. to vii. and tending to duplicate.

Girdle broad, scales very small, elongate, regular, 8-grooved.

Interior white; slits 10-1-10; teeth scallopped.

Dimensions: 11 x 7 mm. (curled).

Habitat: Masthead Reef, Queensland.

Remarks: This shell, several examples of which were collected by Mr. C. Hedley, superficially resembles *Lophochiton*, the colour and the more granular sculpture distinguishing it externally from the plain brownish shells of the rest of the genus. Its interior characters, however, are those of *Callistelasma*. Type in Aust. Mus.

Genus *CALLISTASSECLA*, n. gen.

Type, *Callistochiton mawlei* Iredale and May.

This form is characterised by the continuous sutural laminae, a feature otherwise of family value.

*CALLISTASSECLA MAWLEI*.

(Plate xl., figs. 5 and 7.)

*Callistochiton mawlei* Iredale and May, Proc. Mal. Soc., xii., 1916, 113, pl. iv., f. 5. Port Arthur, Tasmania. Type in Tasmanian Museum. May, Illus. Index Tas. Shells, 1923, pl. xv., f. 7.

Shell medium, elongate oval, elevated, semi-carinated, side slopes a little curved. Colour buff to reddish-brown, the girdle generally banded.

Anterior valve with twelve to fourteen hold elevated ribs, scarcely nodulose, intervals minutely latticed towards the apex.

Median valves: Lateral areas elevated with two ribs, annulate nodulations appearing towards the sides, resembling growth periods; interstices deep and smooth, faint latticing near jugal area; central areas longitudinally regularly lined with elevated ridges, interstices finely latticed, 25 ridges on each side, those on the jugum being closer together.

Posterior valve with mucro depressed, median, post-mucronal slope a little convex owing to the elevated ribs, eleven in number, like those of the anterior valve; ante-mucronal area sculptured as central areas.

Girdle scales minute rounded ovals, deeply grooved.

Interior white; slits 10-1-10, teeth very slightly scalloped; sutural laminae continuous.

Dimensions: 17 x 9.5 mm. (type), 24 x 12.5 mm. (maximum).

Habitat: Southern Tasmania.

Genus *SOLIVAGA*, n. gen.

This distinct genus is based upon a species dredged in shallow water by Surgeon Archer at Singapore, and which we regard as *Callistochiton finschi* Thiele (Revision Chitonon, 1910, 36, pl. viii., f. 57-60). This species was described from two small shells collected by O. Finsch on the East coast of Sumatra (Java Sea) which is practically the same locality. Thiele gave figures of the fifth and eighth valves and one of the girdle scales, and placed it under *Callistochiton*, apparently from its resemblance to some other species he there located by means of the radular characters. We are describing and figuring the Singapore species, so that the Australian shell, regarded as conchologically similar, will be recognised when again found.

[*SOLIVAGA FINSCHI*.

(Plate xl., figs. 14-16.)

Shell roundly oval, elevated, carinated, side slopes straight, girdle broad. Colour buff, sparsely spotted with bluish-green, girdle sometimes banded with bluish-green.

Anterior valve large, a little concave, apex slightly recurved, minutely coarsely pustulose, ray formation developing with age, so that the largest specimens seen (12 x 7 mm., slightly curled) shows fifty regular pustulose rays, not separable near the apex; posterior edge showing faint teeth laterally.

Median valves: Lateral areas sculptured similarly to the anterior valve, the rays forming more slowly, eight to ten rays, toothed on the posterior edge; central areas similarly minutely pustulose, longitudinal rows of larger pustules regularly crossing the valves, more closely packed towards the jugum, twenty being counted on each half.

Posterior valve; mucro ante-median, about anterior third; post-mucronal slope a little concave, sculptured as anterior valve; ante-mucronal area with the sculpture of the central areas.

Girdle broad, clothed with longitudinal oval scales, irregularly packed, with about ten grooves, apices smooth.

Interior white; slits 12-1-10; no scalloping; teeth short, sharp, and Isehnichitoid in appearance; sutural laminae thin, large, the jugal tract intervening in the foremost, a spade-like process arising in the hinder valves, very like that found in *Loricella*.

Dimensions: Maximum 12 x 7 mm. (curled); medium shell, 9 x 6 mm. (Type of *C. finschi* 8.5 x 5.5).

Station: Dredged in shallow water.

Habitat: Singapore.

Remarks: The figured shell is in the Australian Museum].

*SOLIVAGA RECENS*.

*Callistochiton recens* Thiele, Die Fauna Sudwest Aust., iii., 1911, 402. Sharks Bay, Western Australia. Type in Berlin Museum.

Thiele described a minute shell, 5 x 3 mm., giving no figures but stating that his figure of *Callistochiton finschi* (Rev. Chitonien, 56 (Chun Zoologica) 86, pl. 5, f. 57-60) is like the one under review. This species (*finschi*) is conchologically quite unlike any of the shells previously referred to "*Callistochiton*," and such like shells are so classed by Thiele on account of the radular characters. It is quite unlike *Lophochiton*, which is mentioned in connection with it by Ashby.

The following is a translation of Thiele's description:—The colouration is whitish with some washed-out grey and brown flecks, the girdle being banded. The shell is carinated, the side slopes straight; the lateral areas are closely, and towards the outer edge more boldly nodulose, while in the central areas the granules are arranged distinctly in longitudinal rows, not very close together; the slits in the anterior valve correspond with the ribs of the tegmentum. The edges of the terminal valves are somewhat wavy. The anterior valve has ten slits, the posterior valve is irregularly slit; the sutural laminae are broad. The apex of the posterior valve is scarcely elevated; the post-mucronal area is obsoletely rayed. The girdle scales are grooved. Further the shell is similar to that I have figured as *Callistochiton finschi*.

Genus *LOPHOCHITON*.

*Lophochiton* Ashby, Trans. Roy. Soc. S. Aust., xlvii., 1923, 233. Type by original designation *Lophochiton johnstoni* Ashby = *Chiton coccus* Menke.

This generic name was proposed for a supposed *Callistochiton*id without the characteristic festooning of the insertion plates. Simultaneously a closely allied species had been described as a *Callistochiton*. The genus is undoubtedly related to the Australian *Callistochiton*ids, but is well characterised by its extraordinary granose sculpture, its peculiar posterior valve, and the obsolescence of the characteristic festooning of the insertion plates.

Shell small, rounded oval, elevated, carinated, posterior valve with humpy muero. Sculpture like that of *Callistochiton*, overridden by granular pustules. Insertion plates without much festooning, otherwise as in *Callistochiton*. Girdle scales small, typically *Callistochiton*id.

An allied species, referable to this genus, occurs in the Moluecas, being described as *Callistochiton carpenteri* by Nierstrasz (Siboga Exped. Monog., xlviii., 1905, 39, pl. i., f. 11, pl. iii., f. 88-92, Banda), while we have seen an undescribed species from New Caledonia.

*LOPHOCHITON GRANIFER*.

(Plate xl., figs. 9-13.)

*Callistochiton granifer* Hull, Aust. Zool., iii., Aug. 15, 1923, 161, pl. xxv., f. 5-8. Palm Islands, Queensland. Type in Australian Museum.

Shell small, broadly ovate, semi-carinated. Colour buff to greyish-green, occasionally having a few scattered brown spots.

The sculpture generally consists of coarse granules, mostly uniform in size, but very irregularly arranged, and becoming slightly larger towards the periphery.

Anterior valve with twelve to fifteen radiating folds, with very narrow interstices, becoming obsolete posteriorly; apex emarginate.

Median valves: Lateral areas distinctly differentiated, with two bold granose ribs, having a deep sulcus between, and on the posterior edge a line of projecting separated tooth-like processes, all roughly granose; central areas covered with erect granulose pustules, massing into irregular longitudinal lines.

Posterior valve with muero rather behind the middle; post-mueroal slope convex, the post-mueroal area small, sculptured with ten elevated granose ribs; ante-mueroal area long and sloping, granules radially disposed, sharper and more regularly arranged than those in the central areas of the median valves.

Girdle densely clothed with uniform grooved scales.

Interior; white, with bluish spot in valve viii.; slits 9-1-9; sutural laminae small, rounded, distant.

Dimensions: 9 x 5½ mm. (Type, eured), maximum of series collected 14 x 9 mm.

Station: Under stones embedded in mud or coral sand and debris, below low water mark; also dredged in 15 fathoms.

Habitat: Queensland from Capricorn Group to Thursday Island.

Remarks: The type of this species was collected by Mr. C. Hedley off the Palm Islands, north of Townsville, Queensland. Specimens were later collected by one of us at Stone Island, Port Denison, Armit and Grassy Islands in the Whitsunday Group, Howick Islands, north of Cairns, Flinders Islands near Cape Melville, and Thursday Island, Torres Strait. The long series thus obtained has enabled us to modify some details of the original description. The animal, like



other Callistochitonids, shows a preference for muddy or dirty situations, and is frequently associated with *Ischnochiton luticolens*.

LOPHOCHITON COCCUS.

*Chiton coccus* Menke, Zeitschr. für Malak. (Menke), 1844, 62. North West Coast, New Holland. Type ?.

*Lophochiton johnstoni* Ashby, Trans. Roy. Soc. S. Aust., xlvii., 1923, 234, pl. xvi., f. 7a, b, c, pl. xvii., f. 1 a-d. Carnarvon, Western Australia. Type in coll. Ashby.

We have seen a median and the posterior valve of Ashby's type shell, which differs from the preceding species in the colour, which is buff suffused with pinkish, and having a few orange spots on some of the valves. Ashby informs us that the anterior valve is flatter than that of *L. granifer*, the fluting practically absent from the apical half, and the ribs broader and less raised. The sulcus dividing the ribs of the lateral areas is much shallower. The granose sculpture is generally finer. Slits 11-10.

Remarks: This species is undoubtedly the previously undetermined *Chiton coccus* of Menke, taken on the "North-west coast of New Holland, on *Tridacna elongata*." Pilsbry's translation of the original description of this shell is here quoted for comparison:—"Shell elliptical, subdepressed, thin, pellucid, ashey. Terminal valves with granose-nodulose rays, the anterior 11, posterior 10; other valves with the median areas granulose, marked with a brown spot in the middle, roseate posteriorly; lateral areas on each side furnished with a pair of strong radiating granose ribs. Girdle very subtly granulose, hoary variegated with dark spots. Length 4, breadth 2 lines."

The examination of a series of this shell may result in further accentuation of the differences between the western and the eastern species, or possibly, on the other hand, in the reduction of the eastern shell (*granifer*) to subspecific rank.

Family LORICIDAE.

This peculiar family is at present known only from southern Australia and New Zealand, and consists of a few species of medium to large size, depressed or elevated, characterised by the loss of the insertion plate of the posterior valve; in addition the girdle is posteriorly slit or sinuate, this feature being indicated in the posterior valve itself. According to Thiele the radula is so similar to that of *Callistochiton* that he subordinated the shells as a subgenus of that genus. In this he was quite wrong, as the group was already well specialised in the Eocene beds of Victoria and Tasmania, many fossil species having been described, differing very slightly from the existing forms.

Shells medium to large, elevated or depressed, elongated oval to broadly ovate, colouration generally dull, ochraceous, but showing bright tinting. The sculpture may be termed delicate, consisting of scattered pustules, sometimes in ray formation on anterior and posterior valves and lateral areas; central areas more or less ridged with fine lines of coalesced pustules. Girdle covering of scales of varying sizes, with spiculate tufts or corneous processes of complicated growth scattered throughout. Insertion plates striated, obsolete in posterior valve, sutural laminae large, sinus toothed.

Key to the species:—

Girdle covering large irregular striated scales and numerous spiculate tufts:

Posteriorly slit its whole width:

Anterior valve normal . . . . . *Lorica*.

Girdle covering small suberect scales and complicated corneous processes:

Posteriorly slit only half way:

Anterior valve abnormally large . . . . . *Loricella*.

Posteriorly sinuate only, anterior valve normal . . . . . *Kopionella*.

#### Genus LORICA.

*Lorica* H. and A. Adams, Ann. Mag. Nat. Hist., ser. ii., vol. ix., 1852, 355. Type by monotypy *Chiton cimolius* Reeve.

*Aulacochiton* Shuttleworth, Mittheil. Naturf. Gesell. Berne, 1853, 68. Type by monotypy *Chiton volvox* Reeve.

Shell large, elongate oval, elevated, carinated, posterior valve small with recurved terminal mucro, tegmentum weakly slit, girdle slit. Sculpture of small separated erect pustules, sometimes linked into rays or lines. Girdle covered with rounded oval striated scales of varying sizes, with numerous spiculose tufts scattered over the girdle. Anterior valve regularly eight-slit, teeth finely pectinated; median valves one-slit; sutural laminae extending nearly across the valve, sinus consisting of a small deep gap at the jugum only; insertion plates in posterior valve reduced to a striated callus interrupted by a deep sinus below the sinuated mucro.

#### LORICA VOLVOX.

(Plate xl., figs. 18 and 20.)

*Chiton volvox* Reeve, Conch. Leon., iv., 1847, pl. vi., sp. and f. 31. Sydney, New South Wales. (Jukes). Type in Mus. Cuming in Brit. Mus.

*Chiton rudis* Hutton, Trans. N.Z. Inst., iv., 1872, 179. Specimen in Dominion Museum, Wellington, Loc. unknown = New South Wales (Mestayer).

*Lorica volvox* Haddon, Zool. Challenger, xv., 1886, 31. Pilsbry, Man. Conch., xiv., 1893, 237, pl. 52, f. 14-21.

Shell large, elongate oval, carinated, side slopes straight, sutures straight. Colour generally brown to blackish, occasionally having one or more valves dull red or green.

Anterior valve with small erect pustules ranged into radials and coalescing with age, twenty-five to fifty may be counted, some being short or intercalated; apex erect, recurved, callused; posterior edge of valve with projecting pustules, callus adorned with pustules.

Median valves with lateral areas sculptured as anterior, six to ten radials, posterior edge of valve with projecting pustules; central areas ridged with lines of coalesced pustules, imperfectly joined on jugum, twelve to eighteen ridges on each side, ridges a little sinuous, latticed between.

Posterior valve with mucro terminal, recurved; post-mucronal area restricted to a small swollen area on the fold of a ridge forming the posterior edge of the valve; ante-mucronal area sculptured as central areas.

Girdle broad, clothed with rounded oval, striate scales, smaller on the outside, and with many spiculose tufts, one at each suture, eight around the anterior valve, four behind the posterior valve, and three rows alternate with the sutural tufts; fringed with spicules.

Interior white; slits 8-1-0; sutural laminae very broad; teeth finely pectinated.

Dimensions: 78 x 37 mm.

Station: Under stones in muddy positions, below low water mark.

Habitat: New South Wales.

Remarks: This is a sedentary species attaining large proportions, and generally affected by parasitic growths. In old shells and dried specimens which

have not been very carefully preserved the spiculose tufts are frequently reduced in number or even entirely disappear.

LORICA CIMOLIA.

(Plate xl., figs. 19 and 21.)

*Chiton cimolius* Reeve, Conch. Icon., iv., 1847, pl. xxi., sp. and f. 141. Australia (we select South Australia). Type in Mus. Cuming in Brit. Mus.

*Lorica cimolia* Iredale and May, Proc. Mal. Soc., xii., 1916, 112. May, Illus. Index Tas. Shells, 1923, pl. xvi., f. 14.

This distinct species is easily separated from *L. volvox* by the sculpture of the central areas, the linear ridges being distant and the wide interspaces not latticed; the granose sculpture of the terminal valves and the lateral areas is characterised by fewer and more widely spaced grains.

It reaches somewhat larger dimensions, and the spiculose tufts are sparser, and more frequently altogether absent.

Habitat: South Australia, Victoria, Tasmania.

LORICA PAUCIPUSTULOSA.

(Plate xl., fig. 17.)

*Lorica paucipustulosa* Hull, Aust. Zool., iii., 1923, 197, pl. xxvii., f. 3. Rabbit Island, King George Sound, Western Australia. Type in Western Australian Museum.

This western species is easily separated by the still further diminution of the ridging of the central areas, and the still fewer granules on the terminal valves and the lateral areas of the median valves.

Habitat: South Western Australia.

Genus LORICELLA.

*Loricella* Pilsbry, Man. Conch., xiv., 1893, 238. Type by monotypy, *Lorica angasi* H. Adams and Angas. Pilsbry, Proc. Acad. Nat. Sci. Philad., 1894, 86 (full description).

Shell large, rounded oval, depressed when young, elevated and carinated when senile, anterior valve abnormally large and broad, posterior valve small, with low recurved terminal mucro, not slit but sinuate; girdle broad, very much produced in front and partly slit posteriorly. Colouration generally dull. Sculpture rayed on anterior and posterior valves and lateral areas, ridges on central areas; the development of sculpture is somewhat irregular, sometimes very faint, in other cases very pronounced. Girdle covered with very small round scales, among which are bunches of corneous processes of complex design, more noticeable along the anterior edge which is scalloped. Interior with insertion plates in valves i. to vii., strongly pectinate, eight regular slits in anterior, one in median valves; sutural laminae very wide, only separated by a narrow gap under the jugum, into which is inserted a pectinated sinuate block; posterior valve with a sinuate callus showing two obscure lateral slits. [*Squamophora oviformis* Nierstrasz, Sihoga Exped. Monog., xlviii., 1905, 50, pl. i., f. 15, 16, pl. iv., f. 97-101, appears closely allied. This species was dredged in 73 m. 6° N., 121° 30 E.].

LORICELLA ANGASI.

(Plate xl., figs. 22-24.)

*Lorica angasi* H. Adams and Angas, P.Z.S., 1864, 193. Rapid Bay, South Australia. Type in Brit. Mus.

*Chaetopleura rugosa* Angas, P.Z.S., 1867, 223. Port Jackson. Not of Gray or Sowerby.

*Lorica angasi* Pilsbry, Man. Conch., xiv., 1893, 238, pl. 51, f. 9-13.

*Loricella angasi* Pilsbry, Proc. Acad. Nat. Sci. Philad., 1894, 87.

*Loricella torri* Ashby, Trans. Roy. Soc. S. Aust., xliii., 1919, 62, pl. x. Quarantine Station, Port Jackson, N.S.W. Type in coll. Ashby.

Shell as for the genus. Colour generally dull brown or grey, sometimes banded with darker longitudinally; occasionally dull green, rarely blue.

Anterior valve very broad, nearly twice as broad as long, flattened, apex depressed, a few pustules on edge; rayed with eight primary ribs, sometimes many subsidiary ones as strong, so that sixty or more rays may be counted.

Median valves: Lateral areas ribbed as anterior valve, sometimes strongly, in other cases scarcely any ribbing; central areas similarly, sometimes closely ridged throughout, in other examples few of the ridges continue right across the valve, beginning late and extending only half way.

Posterior valve small, depressed, mucro terminal and recurved; post-mucronal area restricted to a linear ridge; ante-mucronal area as central areas.

Girdle generic. Interior white; slits 8-1-0.

Dimensions: 68 x 40 mm.

Station: Under stones in muddy situations below low water mark.

Habitat: New South Wales, Victoria, South Australia, Tasmania.

Remarks: The type locality of *Loricella angasi* being South Australia, the Sydney shell has been separated as a distinct species, but the differential features claimed are merely individual variations, common to the whole range of the species. When series are compared the southern shells appear to grow larger and become more elevated, and to have more "spear heads." The sculpture is as variable, and consequently subspecific value is the most that should be suggested, but even this is a matter of opinion. The south Tasmanian forms differ so little from either the Peronian or Adelaidean shells that they have been classed with the former, which geographically they might be, but in the related genus *Lorica* the south Tasmanian shells belong to the Adelaidean.

#### [LORICELLA BAKERI.]

*Ischnochiton bakeri* Torr., Trans. Roy. Soc. S. Aust., xxxvi., 1912, 169, pl. vii., f. 8a, b, c, f.

"General appearance: Shell almost round, valves narrow, flattened; colour greyish-white mottled with brown.

Anterior valve: Covered with microscopic imbricating pustules, closely packed, resembling girdle scales.

Median valve: Dorsal area triangular, smooth, spotted. Lateral areas distinctly raised with four or five irregular pustules. Median valves covered with microscopic granules.

Posterior valve is missing.

Girdle: Covered with imbricating striated scales. The outer edge of the girdle is fringed with delicate spicules.

Measurement: 4 x 3 mm.

Hab.: Henley Beach (Mr. Baker).

Remarks: Strongly resembles a juvenile *Loricella angasi*, but its striated girdle scales distinguish it."

Note: We have inserted this species, with the author's description, in this place with considerable doubt].



Genus *KOPIONELLA*.

*Kopionella* Ashby, Trans. Roy. Soc. S. Aust., xliii., 1919, 71. Type by original designation *Plaxiphora matthewsi* Iredale.

This peculiar form is here placed with some doubt, but a number of its characters agree with those of members of this family, though the sculpture is in disagreement. The character used for distinguishing the genus was the presence of "peculiar ear-headed bristles or spicules" on the girdle, the other features cited at the time being "minor differences."

Shell medium, moderately elevated, subearinated, rounded oval. Colouration greenish marked with blue-black. Sculpture not unlike that of *Poneroplax*, wavy lines not very nodulose serving as ribs on anterior and posterior valves, lateral areas raised, ribs indistinct, central areas obscurely wavy. Posterior valve with muero terminal and recurved, insertion plates reduced to a callus. Insertion plates in anterior and median valves short, ten-slit in former one-slit in latter; natural laminae broad, sinus small, with spade-like process present in valves vi. and vii.; slits slightly scalloped. Girdle having small erect scales and complex corneous processes.

*KOPIONELLA MATTHEWSI*.

(Plate xl, figs. 25-28.)

*Plaxiphora matthewsi* Iredale, Proc. Mal. Soc., ix., 1910, 99. (Sultana Bay), South Australia. Type in Brit. Mus. Iredale and May, Proc. Mal. Soc., 1916, 101, pl. v., f. 4a, a'. (Tasmania).

*Plaxiphora conspersa* Bednall, Proc. Mal. Soc., ii., 1897, 154, and of other Australian workers since. Not *C. conspersa* Angas.

*Plaxiphora hedleyi* Torr, Trans. Roy. Soc. S. Aust., xxxv., 1911, 103, f. 2 a-f. (*vide* Ashby). Rabbit Island, Albany, South West Australia. Type in coll. Torr.

*Plaxiphora zebra* Torr, *id.*, *ib.*, 106, pl. xxv., f. 6. (*vide* Ashby). Port Esperance, South West Australia; founded on one valve only. Type in coll. Torr.

*Kopionella matthewsi* Ashby, Trans. Roy. Soc. S. Aust., xliii., 1919, 71, pl. xi., f. 1, 1a.

*Kopionella tasmanica* Ashby, *id.*, *ib.*, xlv., 1920, 268, pl. xi., f. 1 a-e. (D'Entrecasteaux Channel). South Tasmania. Type in coll. Ashby. May, Illus. Index Tas. Shells, 1923, pl. xv., f. 9.

Shell, specific characters as given for the genus.

Dimensions: 22 x 13 mm. (Type), 26 x 16 mm. (maximum).

Remarks: The south Tasmanian form has been differentiated specifically, but no such value is apparent in the series examined by us. The South Australian shells vary in elevation and sculpture so that Tasmanian ones agree easily in these details, and the only feature for separation appears to be in the formation of the corneous processes, a doubtful feature as far as yet known.

EXPLANATION OF PLATES.

Plate xxxix.

- Fig. 1. *Terenochiton badius* Hedley & Hull, whole shell.
2. *Terenochiton badius* Hedley & Hull, interior of median valve.
3. *Terenochiton matthewsianus* Bednall, one-half median valve.
4. *Terenochiton liratus* H. Adams & Angas, one-half median valve.
5. *Terenochiton liratus* Iredale & Hull, one-half median valve.
6. *Terenochiton sperandus* Iredale & Hull, whole shell.
7. *Terenochiton erratus* Hull, anterior valve.



8. *Terenochiton erratus* Hull, one-half median valve.
9. *Terenochiton erratus* Hull, posterior valve.
10. *Terenochiton erratus* Hull, girdle scales.
11. *Parachiton columnarius* Hedley & May, whole shell.
12. *Parachiton columnarius* Hedley & May, one-half median valve.
13. *Parachiton litoreus* Iredale & Hull, posterior valve.
14. *Parachiton capricornicus* Iredale & Hull, posterior valve.
15. *Parachiton puppis* Hull, whole shell.
16. *Parachiton puppis* Hull, anterior valve.
17. *Parachiton puppis* Hull, one-half median valve.
18. *Parachiton puppis* Hull, posterior valve.
19. *Parachiton puppis* Hull, girdle scales.
20. *Parachiton opiparus* Iredale & Hull, whole shell.
21. *Parachiton profundus* May, one-half median valve.
22. *Parachiton collusor* Iredale & Hull, one-half median valve.
23. *Icoplax mayi* Torr, whole shell.
24. *Icoplax mayi* Torr, anterior valve.
25. *Icoplax mayi* Torr, one-half median valve.
26. *Icoplax mayi* Torr, posterior valve.
27. *Icoplax mayi* Torr, girdle scales.
28. *Icoplax luminosa* Iredale & Hull, whole shell.
29. *Icoplax luminosa* Iredale & Hull, eyes in anterior valve.
30. *Levicoplax platessa* Gould, whole shell.

## Plate xl.

- Fig. 1. *Eudoxoplax inornata* Tenison-Woods, whole shell.
2. *Callistelasma meridionalis* Ashby, one-half median valve.
  3. *Callistelasma generos* Iredale & Hull, one-half median valve.
  4. *Callistelasma generos* Iredale & Hull, whole shell.
  5. *Callistassecla mawlei* Iredale & May, one-half median valve.
  6. *Callistelasma antiqua* Reeve, one-half median valve.
  7. *Callistassecla mawlei* Iredale & May, whole shell.
  8. *Callistelasma periousia* Iredale & Hull, one-half median valve.
  9. *Lophochiton granifer* Hull, whole shell.
  10. *Lophochiton granifer* Hull, anterior valve.
  11. *Lophochiton granifer* Hull, one-half median valve.
  12. *Lophochiton granifer* Hull, posterior valve.
  13. *Lophochiton granifer* Hull, girdle scales.
  14. *Solivaga finschi* Thiele, whole shell.
  15. *Solivaga finschi* Thiele, one-half median valve.
  16. *Solivaga finschi* Thiele, girdle scales.
  17. *Lorica paucipustulosa* Hull, whole shell.
  18. *Lorica volvox* Reeve, one-half median valve.
  19. *Lorica cimolia* Reeve (= *L. duniana* Hull), one-half median valve.
  20. *Lorica volvox* Reeve, posterior valve and girdle.
  21. *Lorica cimolia* Reeve, posterior valve (side view).
  22. *Loricella angasi* Adams & Angas, whole shell.
  23. *Loricella angasi* Adams & Angas, posterior valve and girdle.
  24. *Loricella angasi* Adams & Angas, girdle processes.
  25. *Kopionella matthewsi* Iredale, whole shell.
  26. *Kopionella matthewsi* Iredale, posterior valve.
  27. *Kopionella matthewsi* Iredale, posterior valve, side view.
  28. *Kopionella matthewsi* Iredale, girdle processes.